



Bitcoin and the Market for Cryptocurrencies

Lawrence H. White

Professor of Economics, George Mason University

OLLI, 24 Sept. 2015





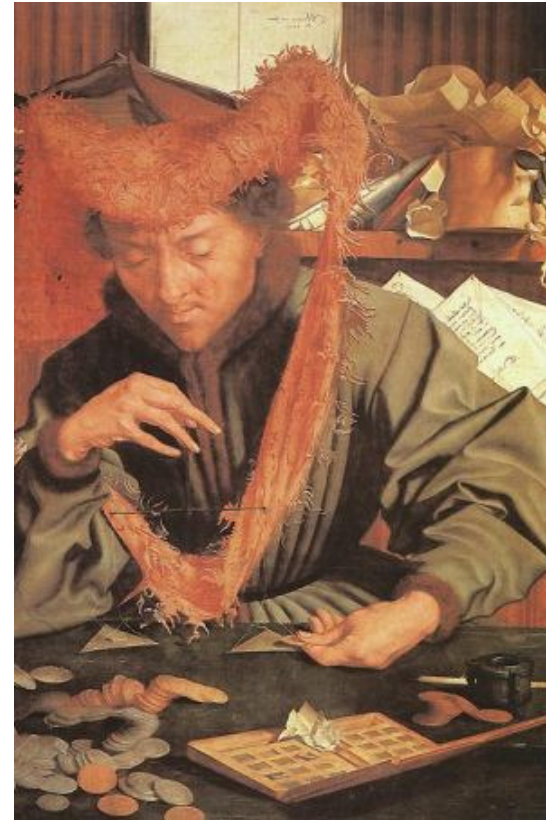




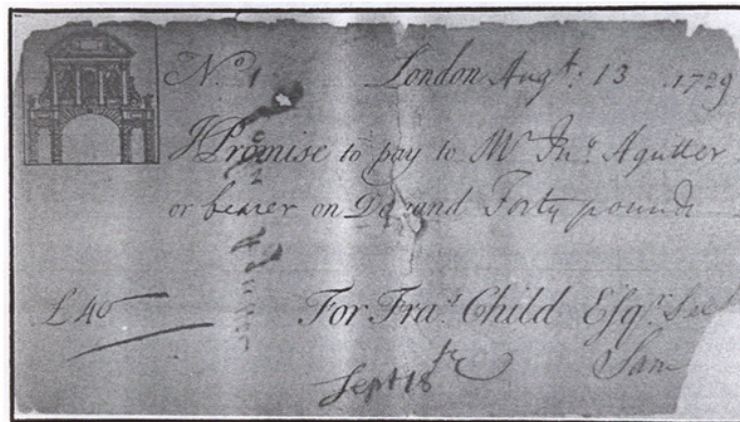
What *is* a Bitcoin?

How does it differ from earlier currencies?

Currency 1.0: precious metal coins



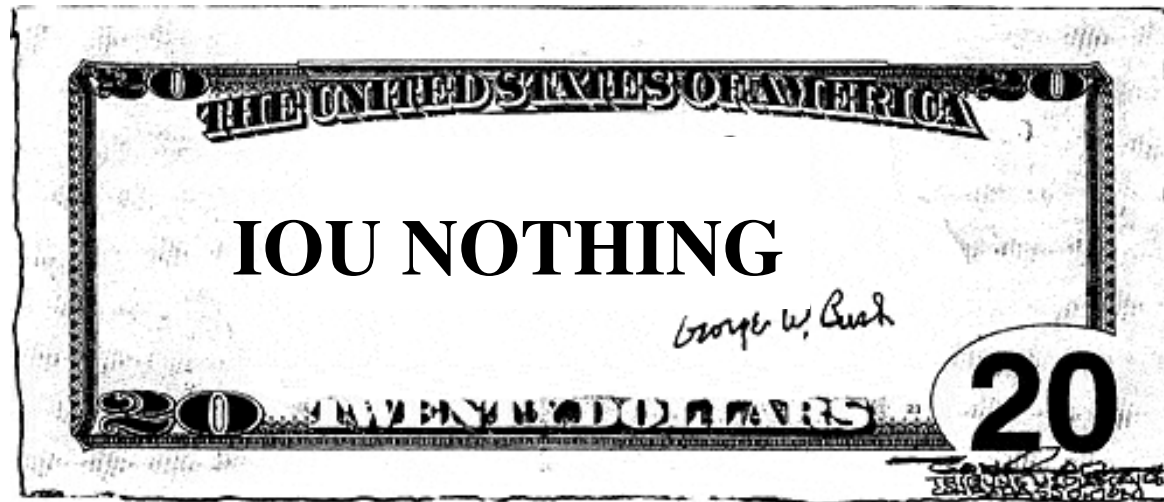
Currency 2.0: Private IOUs redeemable for precious metal coin



Currency 2.1: Government IOUs redeemable for precious metal coin



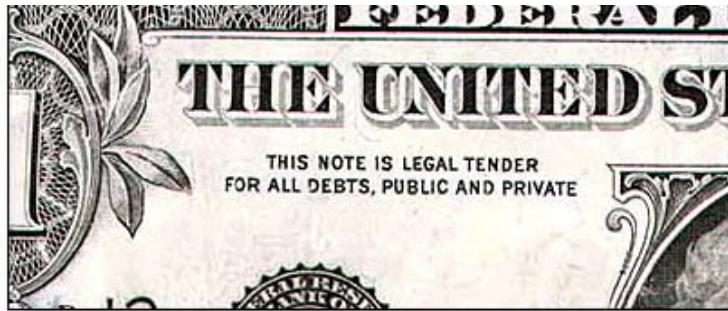
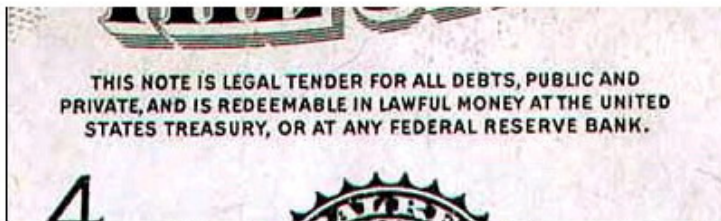
Currency 3.0: Government fiat currency



Why does it have a positive value? Why is there real demand for it?

Legal tender, receivability in taxes, inertia once established (case of Somali shilling).

FR notes before and after



Currency 4.0: private digital “IOU nothing” (authenticity verified by cryptography -- but the value?)



Not a debt contract or liability. Bitcoin isn't even issued by a business enterprise. Rather, by a program launched as a fun project by a community of computer geeks. Who wrote the program? “Satoshi Nakamoto.”

The history of Bitcoin

October 31, 2008

Bitcoin: A Peer-to-Peer Electronic Cash System

Satoshi Nakamoto
satoshi@gmx.com
www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

January 3, 2009: First “block” is “mined”

Block 0²

Short link: <http://blockexplorer.com/0>

Hash²: 00000000019d6689c085ae165831e934ff763ae46a2a6e172b3f1b60a8ce26f

Next block²: [00000000839a8e6886ab5951d76f411475428afc90947ee320161bbf18eb6048](#)

Time²: 2009-01-03 18:15:05

Difficulty²: 1 ("Bits"²: 1d00ffff)

Transactions²: 1

Total BTC²: 50

Size²: 285 bytes

Merkle root²: 4a5e1e4baab89f3a32518a88c31bc87f61876673e2cc77ab2127b7afdeda33b

Nonce²: 2083236893

[Raw block²](#)

Transactions

Transaction ²	Fee ²	Size (kB) ²	From (amount) ²	To (amount) ²
4a5e1e4baa...	0	0.204	Generation: 50 + 0 total fees	1A1zP1eP5QGeG2DMPtHtL5SLmv7DicNa: 50

January 12, 2009: First trial transaction recorded

October 5, 2009: First BTC:USD exchange rate published: US\$1 = BTC1,309.03

February 6, 2010: BTC:USD exchange market launched








May 22, 2010: BTC10,000 publicly traded for two pizzas

July 17, 2010: MtGox exchange is established

How to purchase Bitcoins

<http://www.coindesk.com/information/how-can-i-buy-bitcoins/>

- **(1) Get a bitcoin 'wallet'**
 - “The main options are: (1) a software wallet stored on the hard drive of your computer, (2) an online, web-based service or (3) a 'vault' service that keeps your bitcoins protected offline or multisig[nature] wallet that uses a number of keys to protect the account.”
- **(2) Go to an online exchange to purchase BTC and transfer it into your wallet.**

Exchange	About	Based	
 coinbase	Coinbase operates one of the most popular wallets and is an simple way to buy bitcoin. \$5 bonus on sign up.	USA	BUY BITCOIN
 LocalBitcoins.com	Localbitcoins matches buyers and sellers online and in-person, locally worldwide.	Finland	BUY BITCOIN
 BITQUICK	BitQuick claims to be one of the fastest ways you can buy bitcoin.	USA	BUY BITCOIN
 BitBargain	Bitbargain has a vast range of different payment options for UK buyers.	UK	BUY BITCOIN
 CoinCorner	CoinCorner allow purchases with credit and debit cards for verified users.	Isle of Man	BUY BITCOIN
 BITTYLICIOUS	A peer-to-peer platform for individuals to buy, sell or trade bitcoin and altcoins	UK	BUY BITCOIN
 xapo	Xapo is Known for it's ease of use and bitcoin cold-storage vault.	USA	BUY BITCOIN

639 Currencies / 55 Assets / 2032 Markets

Market Cap: \$ 3,967,156,046 / 24h Vol: \$ 20,285,454

Crypto-Currency Market Capitalizations

23 Sept. 2015

Market Cap ▾ Trade Volume ▾ Other ▾

Search Currencies



All ▾

Currencies ▾

Assets ▾

USD ▾








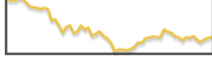



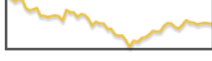



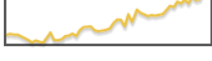




Next 100 →

View All

▲ #	Name	Market Cap	Price	Available Supply	Volume (24h)	% Change (24h)	Price Graph (7d)
1	Bitcoin	\$ 3,382,284,010	\$ 230.96	14,644,775 BTC	\$ 17,310,500	0.12 %	
2	Ripple	\$ 220,726,127	\$ 0.006794	32,488,247,336 XRP *	\$ 794,037	-5.76 %	
3	Litecoin	\$ 121,659,309	\$ 2.87	42,414,535 LTC	\$ 849,103	0.72 %	
4	Ethereum	\$ 66,265,520	\$ 0.902754	73,403,740 ETH	\$ 375,255	1.04 %	
5	BitShares	\$ 15,782,074	\$ 0.006283	2,511,953,117 BTS *	\$ 337,840	0.77 %	
6	Dash	\$ 14,057,031	\$ 2.42	5,812,341 DASH	\$ 34,362	-2.90 %	
7	BanxShares	\$ 12,533,939	\$ 1.75	7,142,171 BANX *	\$ 8,153	0.09 %	
8	Dogecoin	\$ 12,400,575	\$ 0.000123	101,102,904,558 DOGE	\$ 144,268	-2.84 %	
9	Stellar	\$ 10,277,351	\$ 0.002125	4,837,356,606 STR *	\$ 1,399	-0.74 %	
10	Nxt	\$ 8,971,724	\$ 0.008972	999,997,096 NXT *	\$ 49,543	1.58 %	

Crypto-Currency Market Capitalizations

4 Nov. 2014

1	 Bitcoin	\$ 4,426,532,352	\$ 328.77	13,464,000 BTC	\$ 15,742,100	0.04 %	
2	 Ripple	\$ 138,886,638	\$ 0.004791	28,989,252,282 XRP *	\$ 250,358	0.23 %	
3	 Litecoin	\$ 120,072,745	\$ 3.58	33,513,755 LTC	\$ 2,348,410	-0.20 %	
4	 BitSharesX	\$ 33,964,222	\$ 0.016983	1,999,883,512 BTSX *	\$ 129,412	4.71 %	
5	 Dogecoin	\$ 19,974,359	\$ 0.000210	95,098,788,777 DOGE	\$ 291,473	-3.23 %	
6	 Nxt	\$ 19,398,244	\$ 0.019398	999,997,096 NXT *	\$ 34,192	-0.37 %	
7	 Peercoin	\$ 16,488,197	\$ 0.754529	21,852,304 PPC	\$ 109,035	0.78 %	
8	 Counterparty	\$ 11,994,205	\$ 4.53	2,647,161 XCP *	\$ 37,970	9.70 %	
9	 Namecoin	\$ 8,733,659	\$ 0.859701	10,158,950 NMC	\$ 13,577	0.55 %	
10	 Darkcoin	\$ 8,118,309	\$ 1.68	4,826,638 DRK	\$ 62,311	1.81 %	

639 Currencies / 55 Assets / 2032 Markets

Market Cap: \$ 3,967,156,046 / 24h Vol: \$ 20,285,454

Crypto-Currency Market Capitalizations

23 Sept. 2015

Market Cap ▾ Trade Volume ▾ Other ▾

Search Currencies



All ▾

Currencies ▾

Assets ▾

USD ▾

Next 100 →

View All

85.3%

5.6%

3.0%

▲ #	Name	Market Cap	Price	Available Supply	Volume (24h)	% Change (24h)	Price Graph (7d)
1	Bitcoin	\$ 3,382,284,010	\$ 230.96	14,644,775 BTC	\$ 17,310,500	0.12 %	
2	Ripple	\$ 220,726,127	\$ 0.006794	32,488,247,336 XRP *	\$ 794,037	-5.76 %	
3	Litecoin	\$ 121,659,309	\$ 2.87	42,414,535 LTC	\$ 849,103	0.72 %	
4	Ethereum	\$ 66,265,520	\$ 0.902754	73,403,740 ETH	\$ 375,255	1.04 %	
5	BitShares	\$ 15,782,074	\$ 0.006283	2,511,953,117 BTS *	\$ 337,840	0.77 %	
6	Dash	\$ 14,057,031	\$ 2.42	5,812,341 DASH	\$ 34,362	-2.90 %	
7	BanxShares	\$ 12,533,939	\$ 1.75	7,142,171 BANX *	\$ 8,153	0.09 %	
8	Dogecoin	\$ 12,400,575	\$ 0.000123	101,102,904,558 DOGE	\$ 144,268	-2.84 %	
9	Stellar	\$ 10,277,351	\$ 0.002125	4,837,356,606 STR *	\$ 1,399	-0.74 %	
10	Nxt	\$ 8,971,724	\$ 0.008972	999,997,096 NXT *	\$ 49,543	1.58 %	

US\$5.8 b



Lithuania

US\$5.5 b



Guatemala



US\$3.4 b

Costa Rica

US\$3.3 b




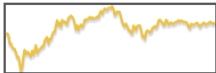





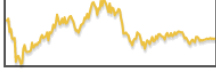

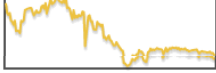

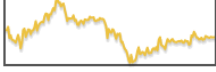

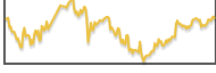

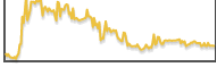






Serbia

US\$3.3 b



(~3x growth)
09 May 2013

Crypto Currency Market Capitalizations


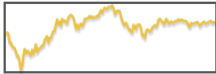





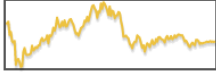









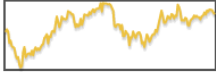




#	Name	Market Cap	Price	Total Supply	% Change (24h)	Graph (7d)
1	 Bitcoin	\$ 1,245,619,548	\$ 111.87	11,134,550 BTC	-1.31 %	
2	 Litecoin	\$ 59,056,771	\$ 3.38	17,491,929 LTC	-1.20 %	
3	 PPCoin	\$ 5,235,373	\$ 0.28	18,870,490 PPC	-4.72 %	
4	 Namecoin	\$ 5,164,296	\$ 0.94	5,495,650 NMC	+0.36 %	
5	 Feathercoin	\$ 1,276,466	\$ 0.20	6,520,050 FTC	-13.15 %	
6	 Terracoin	\$ 1,143,374	\$ 0.46	2,462,790 TRC	+0.64 %	
7	 Devcoin	\$ 1,115,923	\$ 0.00025	4,433,420,050 DVC	+5.38 %	
8	 Freicoin	\$ 1,023,475	\$ 0.049	20,790,846 FRC	-13.15 %	
9	 Novacoin	\$ 957,137	\$ 3.45	277,786 NVC	+0.11 %	
10	 CHNCoin	\$ 869,170	\$ 0.17	4,996,954 CNC	-2.86 %	
11	 BBQCoin	\$ 451,712	\$ 0.027	16,824,318 BQC	-25.75 %	

(~3x growth)
09 May 2013

Crypto Currency Market Capitalizations

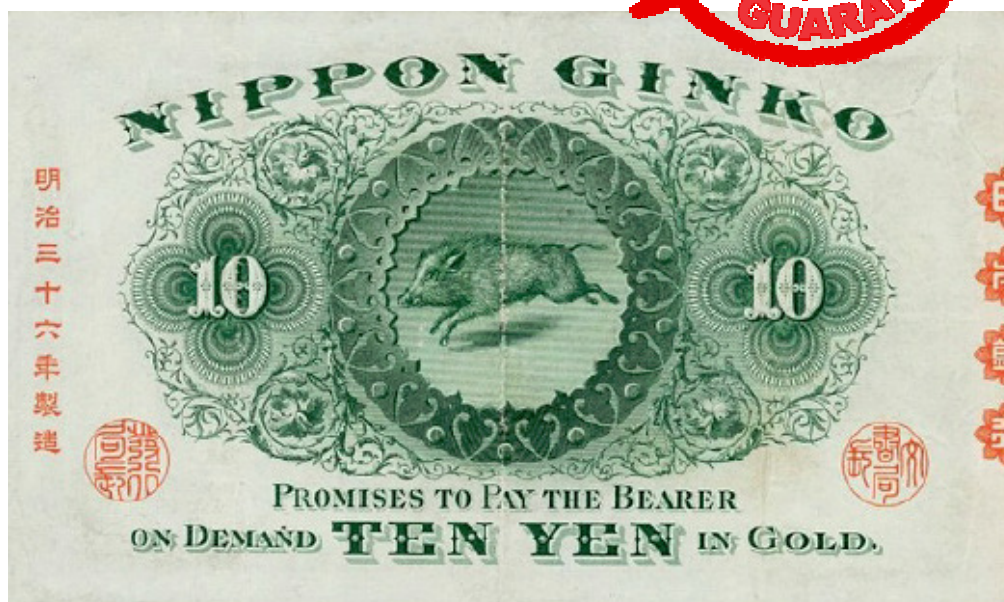
95%



#	Name	Market Cap	Price	Total Supply	% Change (24h)	Graph (7d)
1	 Bitcoin	\$ 1,245,619,548	\$ 111.87	11,134,550 BTC	-1.31 %	
2	 Litecoin	\$ 59,056,771	\$ 3.38	17,491,929 LTC	-1.20 %	
3	 PPCoin	\$ 5,235,373	\$ 0.28	18,870,490 PPC	-4.72 %	
4	 Namecoin	\$ 5,164,296	\$ 0.94	5,495,650 NMC	+0.36 %	
5	 Feathercoin	\$ 1,276,466	\$ 0.20	6,520,050 FTC	-13.15 %	
6	 Terracoin	\$ 1,143,374	\$ 0.46	2,462,790 TRC	+0.64 %	
7	 Devcoin	\$ 1,115,923	\$ 0.00025	4,433,420,050 DVC	+5.38 %	
8	 Freicoin	\$ 1,023,475	\$ 0.049	20,790,846 FRC	-13.15 %	
9	 Novacoin	\$ 957,137	\$ 3.45	277,786 NVC	+0.11 %	
10	 CHNCoin	\$ 869,170	\$ 0.17	4,996,954 CNC	-2.86 %	
11	 BBQCoin	\$ 451,712	\$ 0.027	16,824,318 BQC	-25.75 %	

What gives a private currency value when it isn't made of precious metal? The IOU model





What gives a private currency value when it isn't made of precious metal? The limited-edition model





639 Currencies / 55 Assets / 2032 Markets

Market Cap: \$ 3,967,156,046 / 24h Vol: \$ 20,285,454

Crypto-Currency Market Capitalizations

23 Sept. 2015

Market Cap ▾ Trade Volume ▾ Other ▾

Search Currencies



All ▾

Currencies ▾

Assets ▾

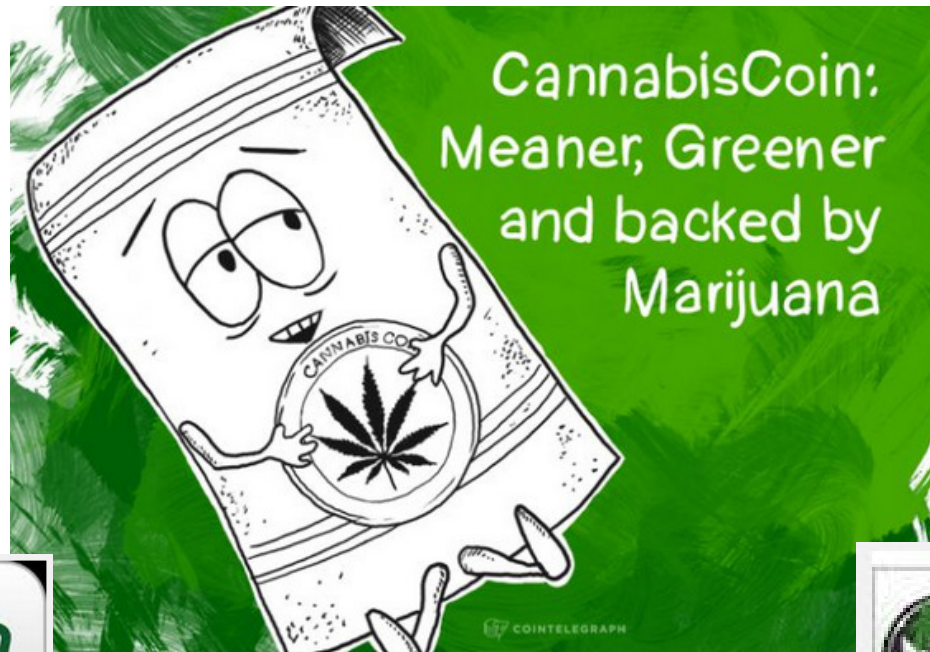
USD ▾

Next 100 →

View All

▲#	Name	Market Cap	Price	Available Supply	Volume (24h)	% Change (24h)	Price Graph (7d)
1	Bitcoin	\$ 3,382,284,010	\$ 230.96	14,644,775 BTC	\$ 17,310,500	0.12 %	
2	Ripple	\$ 220,726,127	\$ 0.006794	32,488,247,336 XRP *	\$ 794,037	-5.76 %	
3	Litecoin	\$ 121,659,309	\$ 2.87	42,414,535 LTC	\$ 849,103	0.72 %	
4	Ethereum	\$ 66,265,520	\$ 0.902754	73,403,740 ETH	\$ 375,255	1.04 %	
5	BitShares	\$ 15,782,074	\$ 0.006283	2,511,953,117 BTS *	\$ 337,840	0.77 %	
6	Dash	\$ 14,057,031	\$ 2.42	5,812,341 DASH	\$ 34,362	-2.90 %	
7	BanxShares	\$ 12,533,939	\$ 1.75	7,142,171 BANX *	\$ 8,153	0.09 %	
8	Dogecoin	\$ 12,400,575	\$ 0.000123	101,102,904,558 DOGE	\$ 144,268	-2.84 %	
9	Stellar	\$ 10,277,351	\$ 0.002125	4,837,356,606 STR *	\$ 1,399	-0.74 %	
10	Nxt	\$ 8,971,724	\$ 0.008972	999,997,096 NXT *	\$ 49,543	1.58 %	





Bitcoin Charts



Zoom 1d 7d 1m 3m 1y YTD **ALL**

From Apr 28, 2013 To Sep 23, 2015



— Market Cap — Price (USD) — Price (BTC) ■ 24h Vol





Freicoin Charts

1 Day

7 Day

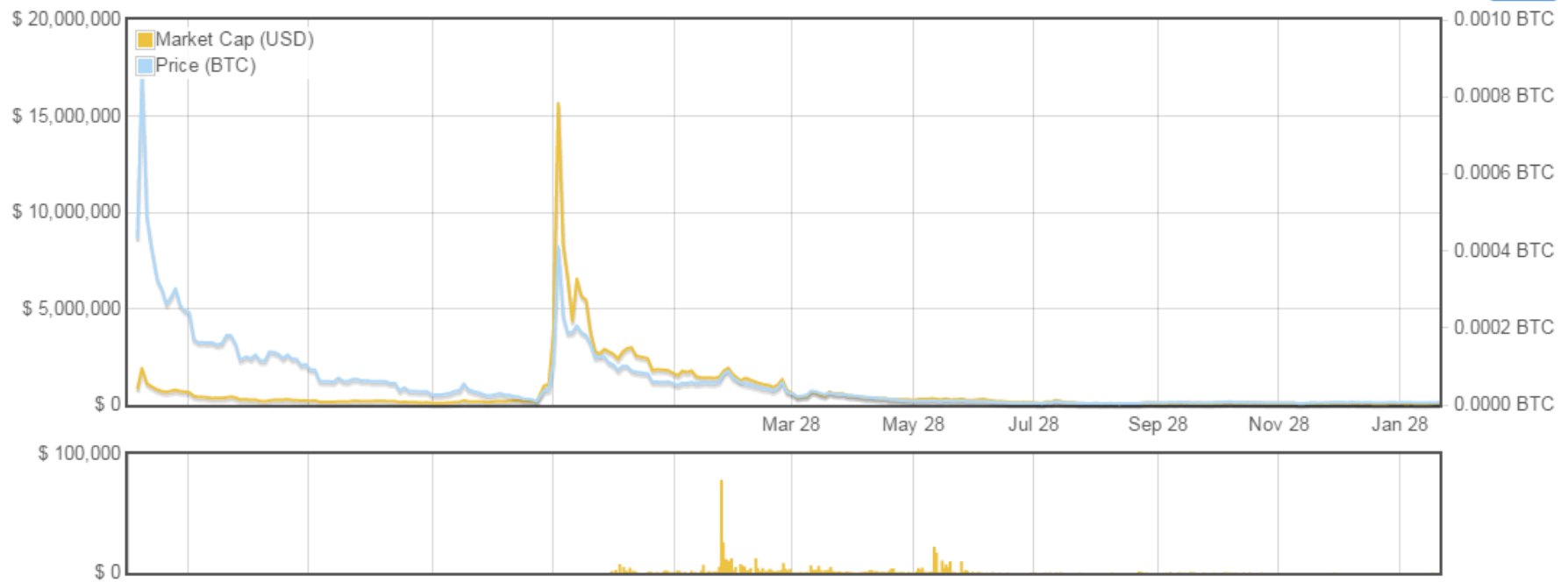
30 Day

90 Day

180 Day

365 Day

All



<http://coinmarketcap.com/currencies/freicoin/#charts>

Peak market cap: \$16.1m (#10) Current market cap: \$0.1m



Megacoin Charts

1 Day

7 Day

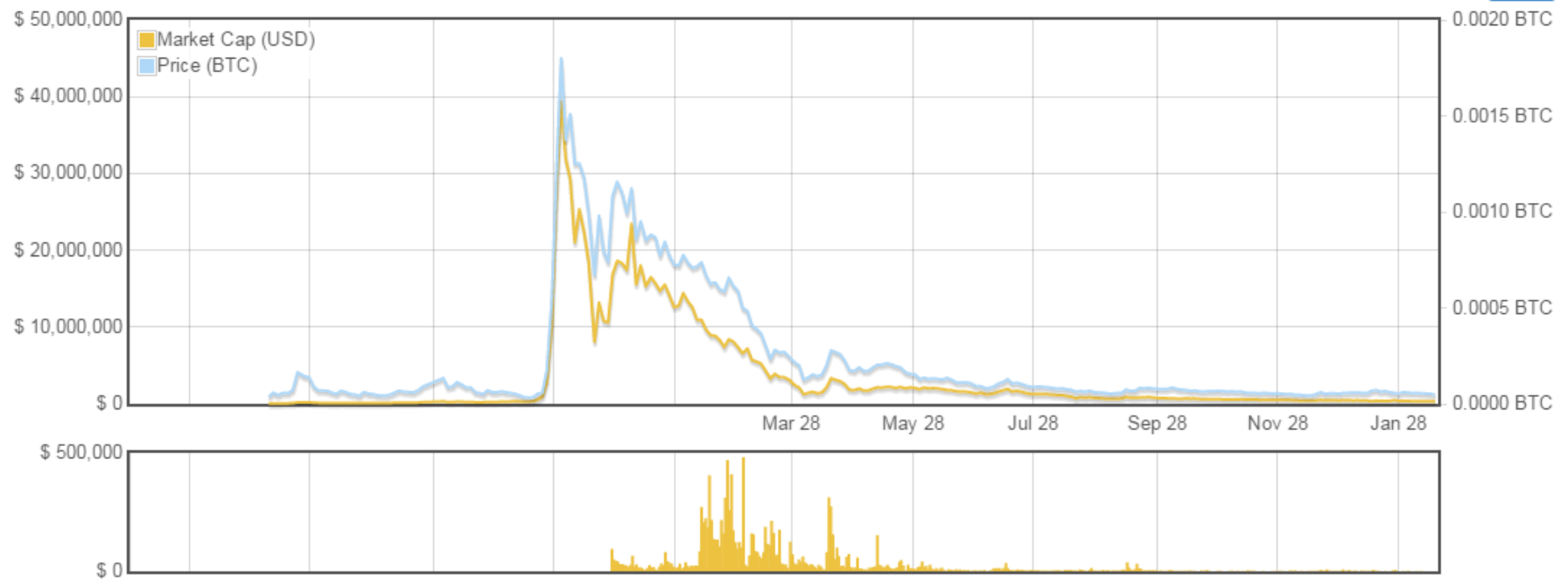
30 Day

90 Day

180 Day

365 Day

All



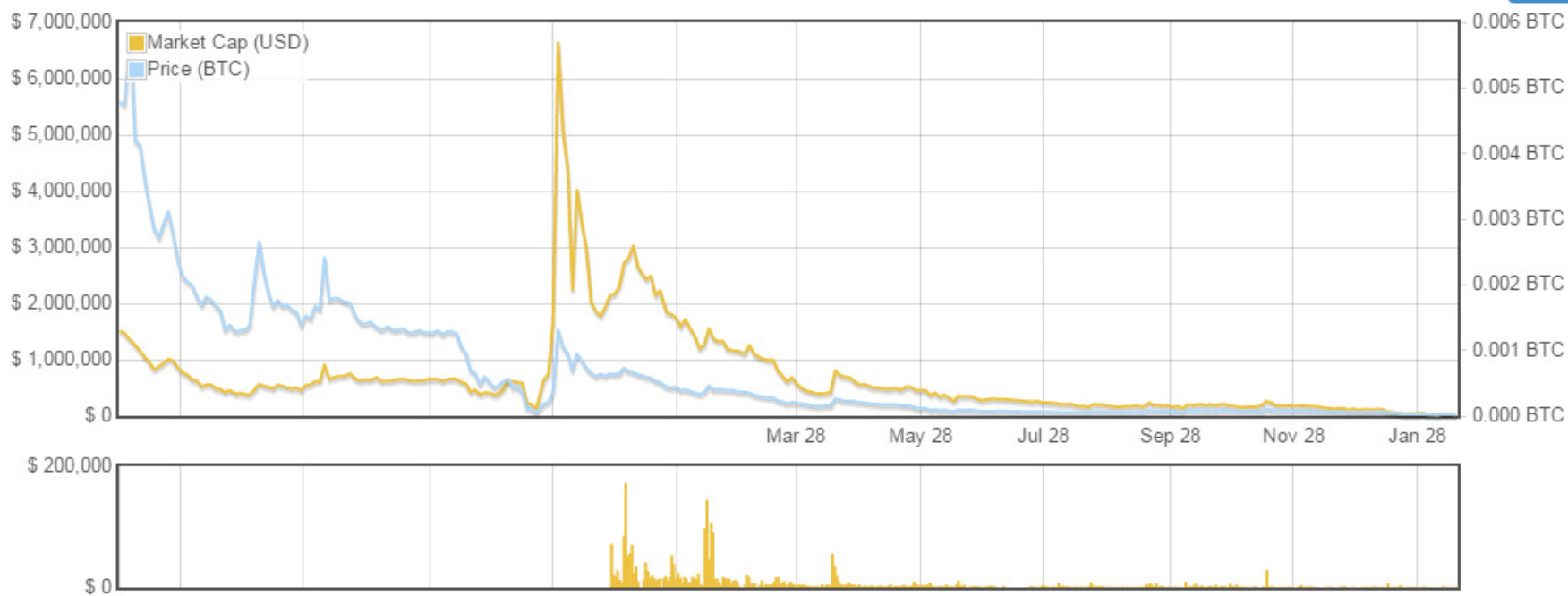
<http://coinmarketcap.com/currencies/megacoin/#charts>

Peak market cap: \$49.8m (#5) Current market cap: \$0.7m





Terracoin Charts

[1 Day](#)[7 Day](#)[30 Day](#)[90 Day](#)[180 Day](#)[365 Day](#)[All](#)

<http://coinmarketcap.com/currencies/terracoin/#charts>

Peak market cap: \$7.1m (#14) Current market cap: \$0.1m



BBQCoin Charts

1 Day

7 Day

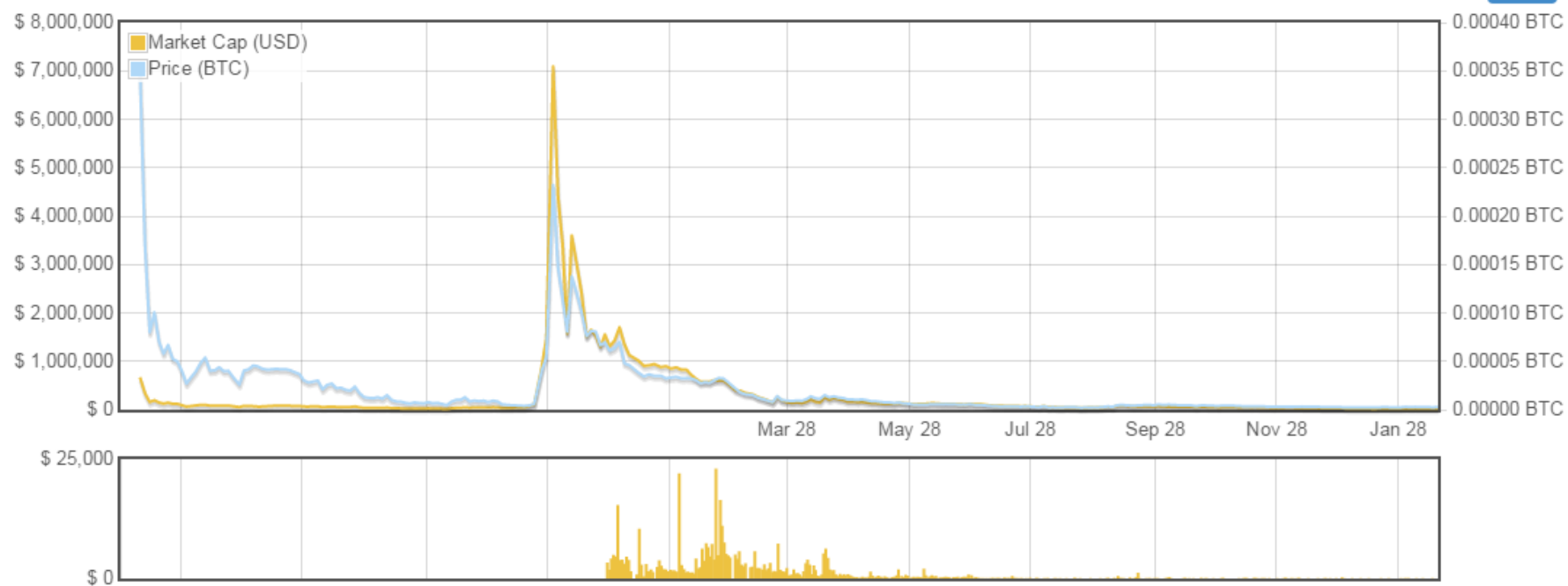
30 Day

90 Day

180 Day

365 Day

All



<http://coinmarketcap.com/currencies/bbqcoin/#charts>

Peak market cap: \$7.0m Current market cap: \$0.06m



Mooncoin Charts

1 Day

7 Day

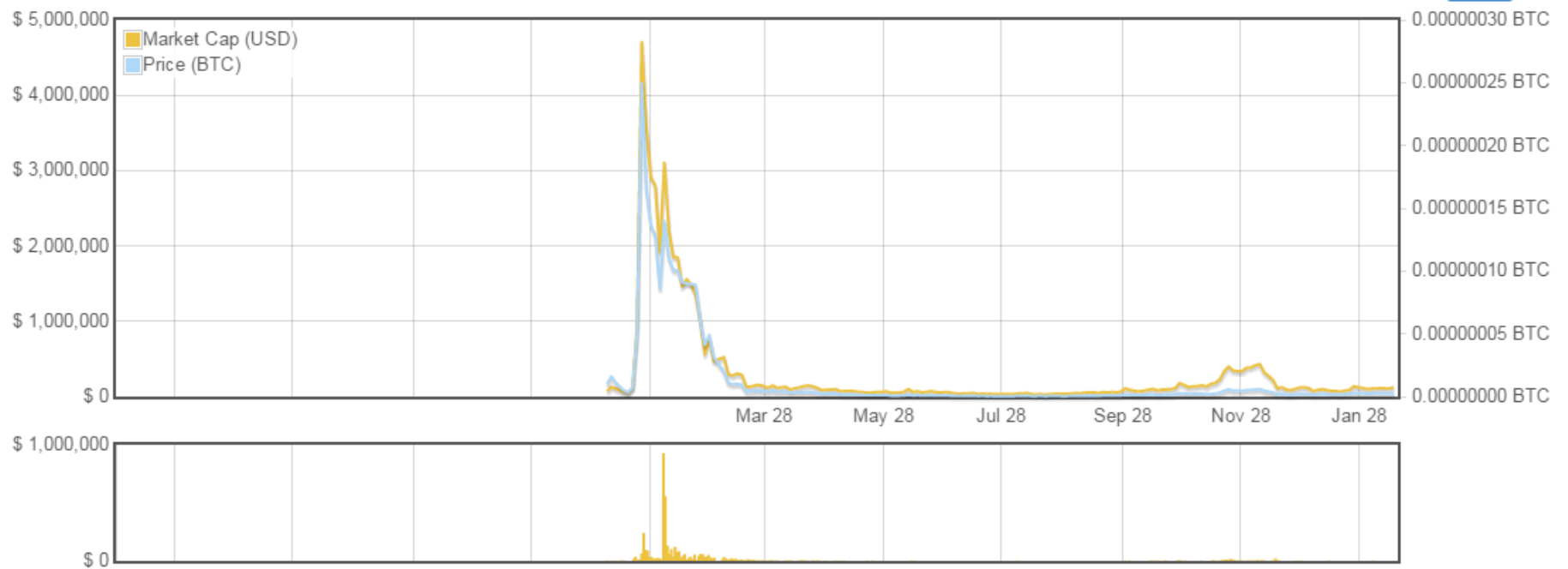
30 Day

90 Day

180 Day

365 Day

All



<http://coinmarketcap.com/currencies/mooncoin/#charts>

Peak market cap: \$4.4m Current market cap: \$0.13m



Bitcoin Charts



Zoom 1d 7d 1m 3m 1y YTD **ALL**

From Apr 28, 2013 To Sep 23, 2015



— Market Cap — Price (USD) — Price (BTC) ■ 24h Vol





Bitcoin has “a status of quasi-monopoly in the realm of digital currencies by virtue of its first-mover advantage.”

Francois Velde, FRB Chicago

In fact: Bitcoin has a large (although shrinking) market share, but NO monopoly power.

Entry is open

Bitcoin cannot restrict quantity (which is pre-programmed) to achieve a monopoly price.



Brad DeLong, UC Berkeley

“[U]nless BitCoin going can somehow successfully differentiate itself from the latecomers [“altcoins”] who are about to emerge, the money supply of BitCoin-like things is infinite because the cost of production of them is infinitesimal.”

“BitCoin is like fiat money, and unlike 18th and 19th century Yap stone money, in that its cost of production is zero.”

In fact: Bitcoin is as well differentiated from altcoins as the US dollar is from the Zimbabwe dollar. Hyperexpansion of the volume of Z\$ does not erode the value of US\$. Cost of production of the marginal altcoin is nearly infinitesimal, yes, but that means only that *its* value is nearly zero. It doesn't erode the value of Bitcoin. Bitcoin's "cost of production" is not zero in the sense that additional Bitcoins could be gratuitously produced. The volume of Bitcoins is on a pre-programmed path.

23 Sept. 2015

<http://www.cryptocoincharts.info/main/priceBoxes>

Cryptocurrencies market prices

Filter markets [All](#) / [BTC](#) / [LTC](#) / [XPM](#) / [DOGE](#) / [Fiat](#) Sort by [Volume](#)

BTC / USD

▶ **230.2900 USD**

-0.0043% in the last 12 hours

17,700.1 BTC	Vol.	4,056,900 USD
228.1300 USD	L / H	231.5000 USD
230.2900 USD	Fiat val	170.4968 EUR

BTC / EUR

▶ **206.6400 EUR**

-0.1591% in the last 12 hours

3,276.71 BTC	Vol.	676,981 EUR
205.2000 EUR	L / H	208.0000 EUR
279.1086 USD	Fiat val	206.6400 EUR

LTC / USD

▼ **2.825030 USD**

-0.3608% in the last 12 hours

36,252.0 LTC	Vol.	103,047 USD
2.800020 USD	L / H	2.880390 USD
2.825030 USD	Fiat val	2.091530 EUR

USD / RUR

▲ **67.45900 RUR**

0.6265% in the last 12 hours

31,356.1 USD	Vol.	2,111,482 RUR
67.01400 RUR	L / H	67.95000 RUR
2.091296 USD	Fiat val	1.542368 EUR

BTS / USD

▼ **0.006642 USD**

-8.209% in the last 12 hours

3,121,368 BTS	Vol.	21,717.7 USD
0.006620 USD	L / H	0.007280 USD
0.006642 USD	Fiat val	0.004917 EUR

BTC / RUR

▶ **15,400.0 RUR**

-0.0071% in the last 12 hours

549,7815 BTC	Vol.	8,426,654 RUR
15,035.0 RUR	L / H	15,600.0 RUR
477.4154 USD	Fiat val	352.1022 EUR

LTC / BTC

▲ **0.012410 BTC**

0.5673% in the last 12 hours

41,328.8 LTC	Vol.	512.5843 BTC
0.012300 BTC	L / H	0.012510 BTC
2.857899 USD	Fiat val	2.115865 EUR

BTC /

▼ **255.7545**

-99.0737% in the last 12 hours

321.0871 BTC	Vol.	110,157
248.1390	L / H	28,679.9
— USD	Fiat val	— EUR

EUR / USD

▲ **1.126370 USD**

0.6433% in the last 12 hours

7,907.56 EUR	Vol.	8,866.24 USD
1.114200 USD	L / H	1.133000 USD
1.126370 USD	Fiat val	0.833916 EUR

BTS / BTC**▲ 0.026930 mBTC****4.8268%** in the last 12 hours

7,417,023 BTS	Vol.	195.1756 BTC
0.000025 BTC	L / H	0.000027 BTC
0.006202 USD	Fiat val	0.004591 EUR

PPC / USD**▼ 0.380000 USD****-1.5544%** in the last 12 hours

11,684.3 PPC	Vol.	4,433.81 USD
0.371000 USD	L / H	0.389000 USD
0.380000 USD	Fiat val	0.281336 EUR

NMC / USD**▲ 0.374000 USD****0.8086%** in the last 12 hours

8,934.61 NMC	Vol.	3,356.89 USD
0.368000 USD	L / H	0.383000 USD
0.374000 USD	Fiat val	0.276893 EUR

CON / BTC**▲ 0.009390 mBTC****18.8608%** in the last 12 hours

10,473,749 CON	Vol.	96.10049 BTC
0.000008 BTC	L / H	0.000010 BTC
0.002162 USD	Fiat val	0.001601 EUR

DOGE / BTC**▼ 0.000530 mBTC****-1.8519%** in the last 12 hours

175,889,975 DOGE	Vol.	92.57739 BTC
0.000001 BTC	L / H	0.000001 BTC
0.000122 USD	Fiat val	0.000090 EUR

DOGE / USD**▲ 0.129000 mUSD****2.1944%** in the last 12 hours

23,239,211 DOGE	Vol.	2,933.32 USD
0.000126 USD	L / H	0.000129 USD
0.000129 USD	Fiat val	0.000096 EUR

NVC / USD**▲ 0.998000 USD****0.8081%** in the last 12 hours

2,726.62 NVC	Vol.	2,700.40 USD
0.978000 USD	L / H	1.000000 USD
0.998000 USD	Fiat val	0.738876 EUR

LTC / EUR**▲ 2.565000 EUR****0.9843%** in the last 12 hours

3,752.92 LTC	Vol.	9,708.75 EUR
2.512620 EUR	L / H	2.609990 EUR
3.464546 USD	Fiat val	2.565000 EUR

PPC / BTC**► 0.001680 BTC****0%** in the last 12 hours

25,853.3 PPC	Vol.	43.28981 BTC
0.001650 BTC	L / H	0.001710 BTC
0.386887 USD	Fiat val	0.286435 EUR

DASH / BTC**▼ 0.010428 BTC****-1.5472%** in the last 12 hours

3,671.03 DASH	Vol.	39.14035 BTC
0.010356 BTC	L / H	0.010942 BTC
2.401413 USD	Fiat val	1.777903 EUR

XRP / BTC**▼ 0.028490 mBTC****-6.8345%** in the last 12 hours

1,137,127 XRP	Vol.	34.04519 BTC
0.000028 BTC	L / H	0.000032 BTC
0.006561 USD	Fiat val	0.004857 EUR

NMC / BTC**▲ 0.001650 BTC****1.8519%** in the last 12 hours

17,303.6 NMC	Vol.	27.84416 BTC
0.001580 BTC	L / H	0.001660 BTC
0.379979 USD	Fiat val	0.281320 EUR